



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/653,561	08/31/2000	Larry Hillyer	M4065.0239/P239	5354
24998	7590	12/30/2005	EXAMINER	
DICKSTEIN SHAPIRO MORIN & OSHINSKY LLP			NGUYEN, HA T	
2101 L Street, NW			ART UNIT	
Washington, DC 20037			PAPER NUMBER	
			2812	

DATE MAILED: 12/30/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/653,561

Applicant(s)

HILLYER ET AL.

Examiner

Ha T. Nguyen

Art Unit

2812

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 10-6-5.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-4,6-18,20-31,34-39,41-44,50,52-82,84-95 and 97 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-4,6-18,20-31,34-39,41-44,50,52-82,84-95 and 97 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## **DETAILED ACTION**

### ***Notice to applicant***

1. Applicants' Amendment and Response to the Office Action mailed 6-6-5 has been entered and made of record .

### ***Claim Rejections - 35 USC § 103***

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103 and potential 35 U.S.C. 102(f) or (g) prior art under 35 U.S.C. 103(a).

3. Claim 54 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zhao et al. (USPN 6204192, hereinafter "Zhao"), in view of Chen (USPN 5970376).

Referring to Figs. 1-8 and related text, Zhao discloses a method for removing polymer etch residue from an etched opening in a silicon wafer device, comprising the steps of: contacting said opening with a first plasma to remove a portion of said etch residue, stopping said first plasma contacting before said polymer etch residue is completely removed and thereafter removing any remaining said residue by contacting said opening with a second plasma, said second plasma consisting of a hydrogen containing gas (See col. 4, line 37- col. 5, line 39).

Zhao also discloses removing photoresist by oxygen ashing (see col. 1, lines 54-63). It is inherent that some residue is also removing in the ashing step. Because the second plasma reducing any existing silicon oxide, the first and the subsequent contacting with said first and said second plasma prevent the formation of silicon oxide in said opening. But it fails to disclose expressly first plasma consisting of oxygen. However, the missing limitation is well known in the art because Chen discloses this feature (See cols. 10 and 11).

A person of ordinary skill is motivated to modify Zhao with Chen to remove photoresist by a conventional process .

Therefore, it would have been obvious to combine Zhao with Chen to obtain the invention as specified in claim 54.

Note: Because of the large number of claims the following rejection will mainly address the claimed features and may not, at every rejection, specifically indicate the identification number of all the claims containing the rejected features.

4. Claims 1-4, 6-18, 20-31, 34-39, 41-44, and 54-91 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhao in view of Smith (USPN 6277733)

[Re claims 1, 16, and 29] Zhao discloses substantially the limitations of claims 1, 16, and 29, as shown above. But it fails to disclose expressly the use of  $\text{NH}_3$  and the removal of nitride by phosphoric acid.

However, the missing limitations are well known in the art because Smith discloses that ammonia and  $\text{H}_2$  are equivalent gases for removing organic containing material (see col. 4, lines 8-26). In the case where ammonia is used, it is inherent that nitride is formed and the cleaning of opening by phosphoric acid as conventionally done removes residue including the formed nitride.

[Re claims 54 and 70] Zhao discloses substantially the limitations of claims 54 and 70, as shown above. But it fails to disclose the first plasma of oxygen. However, Smith discloses that photoresist is etched with plasma of oxygen (see col. 3, lines 37-55).

[Re claims 2 and claims reciting similar feature(s)] Smith also discloses wherein said opening is a HAR contact opening (see Fig. 2f);

[Re claims 3 and claims reciting similar feature(s)] wherein said contacting is performed under conditions effective to remove said etch residue without substantially increasing the size of said opening (See col. 1, 54-56); and

[Re claims 4 and claims reciting similar feature(s)] wherein said opening is contacted with ammonia, H<sub>2</sub>, or CH<sub>4</sub> gas in the absence of oxygen (See col. 4, lines 8-48).

[Re claims 6 and claims reciting similar feature(s)] Zhao also discloses wherein said contacting with said second plasma is done at a temperature within the range of about 250-500° C (see col. 5, lines 5-22);

[Re claims 12-13 and claims reciting similar feature(s)] wherein said contacting with said second plasma is performed for a period of less than about 100 seconds; for a period of not more than about 75 seconds (see col. 5, lines 23-39);

[Re claims 14 and claims reciting similar feature(s)] forming a conductive layer at the bottom of said opening following said contacting step (see col. 5, lines 40-51);

[Re claims 15 and claims reciting similar feature(s)] in the case nitrogen containing plasma is used for the second plasma silicon nitride is formed at a bottom of said opening (see col. 4, lines 17-36), and the removal of said silicon nitride by phosphoric acid is a conventional practice to clean up the opening ;

[Re claims 26 and claims reciting similar feature(s)] wherein said bottom of said opening is not oxidized during said second plasma contacting step (see par. bridging cols. 4 and 5).

[Re claims 7-11 and claims reciting similar feature(s)] Zhao discloses substantially the limitations of claims 7-11 and claims reciting similar feature(s), as shown above. But it fails to disclose expressly the details about said opening and the conditions for applying the first or second plasma. However any variation in parameters in the present claims is obvious in light of the cited art, because the changes in parameters produce no unexpected function.

The routine varying of parameters to produce expected changes are within the ability of one of ordinary skill in the art. Patentability over the prior art will only occur if the parameter variation produces an unexpected result. In re Aller, Lacey and Hall, 105 U.S.P.Q. 233, 235. In re Reese 129 U.S.P.Q. 402, 406.

[Re claims 41-44] Zhao also discloses wherein an insulating layer is formed on said device prior to said etching and said etching forms a contact hole in said insulating layer by dry

Art Unit: 2812

etching; said dry etching is performed using at least one gas selected from the group consisting of  $\text{CH}_2\text{F}_2$ ,  $\text{CHF}_3$ ,  $\text{CH}_2\text{F}_6$ ,  $\text{C}_2\text{HF}_5$ ,  $\text{CH}_3\text{F}$  (See col. 4, lines 17-36).

Therefore, it would have been obvious to combine with to obtain the invention as specified in claims 1-4, 6-18, 20-31, 34-39, 41-44, 54-82, and 84-91.

5. Claims 50, 52-53, 92-95, and 97 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhao in view of Smith, as applied above, and further in view Kawai (USPN 6284664) and Hamada (USPN 6291890).

The combined teaching of Zhao and Smith discloses substantially the limitations of claims 50, 52-53, 92-95, and 97, as shown above.

But it fails to disclose expressly forming an insulating layer over a polysilicon region; forming a Ti silicide layer at the bottom of said opening in contact with said polysilicon layer.

However, the missing limitations are well known in the art because Kawai discloses forming an insulating layer 18 over a polysilicon region 14; forming a contact opening in said insulating layer down to said polysilicon region using a fluorine containing gas (see col. 4, lines 4-18); removing polymer residue from said contact opening using a gas (see col. 4, lines 26-58) and Hamada discloses forming a titanium silicide 111 at the bottom of an opening in contact with said polysilicon layer 104; forming a conductor 112 in said opening in electrical contact with said silicide (see Fig. 3D and col. 5, lines 1-20).

A person of ordinary skill is motivated to modify Zhao and Smith with Kawai and Hamada to obtain improved connection conductivity to a gate region.

Therefore, it would have been obvious to combine Zhao and Smith with Kawai and Hamada to obtain the invention as specified in claims 50, 52-53, 92-95, and 97.

### ***Response to Amendment***

6. In view of Applicants' arguments and amendment to the claims, the rejection of claims 50, 52-69, 92-95, and 97 under 35 U.S.C. 112 first paragraph is withdrawn.

Applicants' arguments with regard to the rejections under 35 U.S.C. 103 have been fully considered, but they are not deemed to be persuasive for at least the following reasons.

Applicants' main argument is that the cited references do not teach the use of two separated plasma to remove the etch residue, Zhao discloses the disadvantages of ashing and nowhere in Zhao the use of ashing is to remove etch residue being taught; Applicants argued that Zhao in view of Chen does not teach "contacting said opening with a first plasma to remove a portion of said etch residue, stopping said first contacting; and subsequently contacting said opening with a second plasma to remove the remainder of said polymer etch residue". The examiner disagreed, even though Zhao expressly discloses cleaning residue with hydrogen plasma, Zhao also discloses a step of removing photoresist by ashing (conventionally done with oxygen plasma), as shown in the rejection. The examiner argued that the oxygen plasma used to remove the photoresist also inherently remove the etch residue. It is well known in the art that the etching of openings in low k dielectric material containing at least organic portions results in polymeric residue, which is inherently removed by oxygen plasma (see Chen, par. bridging cols. 2-3). Because the oxygen plasma photoresist removing step is performed before the hydrogen plasma etch residue removing step, the contacting with oxygen has to stop before all the residue is removed and the remaining residue, including the metal oxide residue caused by the exposure of metal to oxygen plasma, is removed by the hydrogen plasma. If there is no resist left after the oxygen plasma then there is no need for a hydrogen plasma cleaning. Note that applicants' first plasma is also a conventional oxygen plasma (see first par. of page 13), therefore the same effects would have been obtained. Even Zhao discloses some problem with removing photoresist with ashing, a standard practice in the art, measures are proposed to address this problem to have a working process, including Chen's invention. Even though Zhao main invention is the use of hydrogen containing plasma to remove etch residue, but because the oxygen plasma ashing inherently remove some of the etch residue, this step satisfies the claimed limitation of first plasma etching step. Note that the motivation for combining the references were given in each rejection. The expectation of some advantage is the strongest rationale for combining references (MPEP 2144). Besides, it is well known in the art that ammonium chloride or phosphoric acid is used to remove nitride.

Therefore, the cited references do teach or make obvious all the limitations of the rejected claims.

Art Unit: 2812

***Conclusion***

7. The prior art relevant to the disclosure of this application and not being used in the rejections.

USPN 6277752 to Chen for teaching the simultaneous etching of etch residue and photoresist by oxygen containing plasma (see second plasma 22).

8. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ha T. Nguyen whose telephone number is (571) 272-1678. The examiner can normally be reached on Monday-Friday from 8:30AM to 6:00PM, except the first Friday of each bi-week. The telephone number for Wednesday is (703) 560-0528.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael S. Lebentritt, can be reached on (571) 272-1873. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

HN

12- 27 -05



Ha Nguyen

Primary Examiner